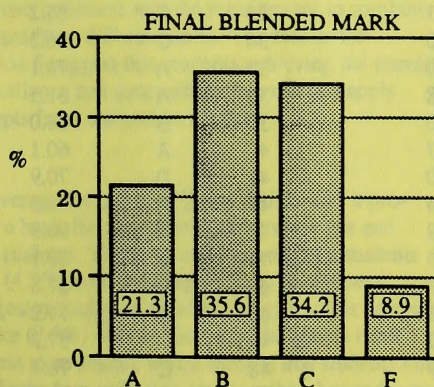
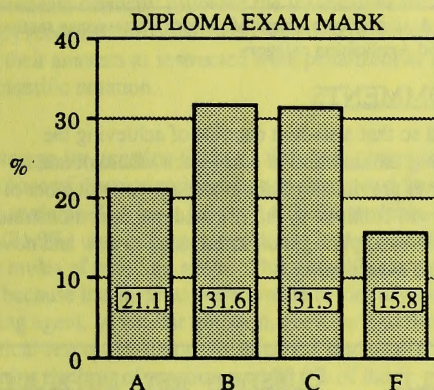
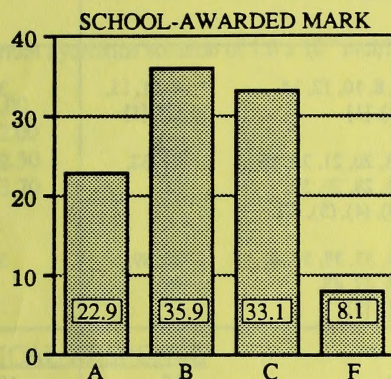


APR - 3 1991

Chemistry 30 Diploma Examination Results



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1991 administration of the Chemistry 30 Diploma Examination. The information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results will be available by the end of 1991.

DESCRIPTION OF THE EXAMINATION

The Chemistry 30 Diploma Examination consists of three parts: a multiple-choice section of 49 questions worth 70%, a numerical-response section of seven questions worth 10%, and a written-response section of three questions worth 20%.

ACHIEVEMENT OF STANDARDS

The information reported is based on the final blended marks achieved by 6 987 students who wrote the January 1991 examination.

- 91.1% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 21.3% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

PROVINCIAL AVERAGES

- The average school-awarded mark was 67.6%.
- The average diploma examination mark was 65.5%.
- The average final blended mark, representing an equal weighting of the diploma examination and school-awarded marks, was 67.1%.

SUBTEST RESULTS

When analysing any detailed examination results, please bear in mind that subtest results cannot be directly compared. Results are in average raw scores.

Machine scored: 37.80 out of 56

Written response: 8.00 out of 14

•Course Content

- Chemical Energetics: 14.25 out of 22
- Acids and Bases: 15.05 out of 24
- Oxidation-Reduction: 16.50 out of 24

•Process Skills: 19.49 out of 34

- Multiple-choice questions 4, 11, 12, 15, 25, 26, 27, 28, 29, 30, 31, 32, 36, 44, 47, 48, and 49; numerical-response questions 2, 4, and 6; and written-response questions 1, 2, and 3.

•Cognitive Levels

- Knowledge: 14.81 out of 20
- Comprehension and Application: 26.94 out of 41
- Higher Mental Activities: 4.05 out of 9

EXAMINATION BLUEPRINT

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in January 1991 according to these classifications. Numbers with square brackets [] indicate written-response questions, those with round brackets () indicate numerical-response questions, and those without brackets indicate multiple-choice questions.

Reporting Category	Questions by Cognitive Level			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Chemical Energetics	1, 2, 3, 5, 7, 9, 13	6, 8, 10, 12, 14, (1), [1]	4, 11, 15, (2), [1]	32
Acids and Bases	16, 17, 19, 22, 23, 27	18, 20, 21, 24, 25, 26, 28, 29, 30, (3), (4), (5), [2]	31, 32, [2]	34
Oxidation-Reduction	33, 35, 40, 41, 42, 43, 46	34, 37, 38, 39, 44, 45, 47, 48, (7), [3]	36, 49, (6)	34
Examination Emphasis (%)	29	51	20	100

Note: For reporting purposes, the Higher Mental Activities component of the written-response section has been combined with the Comprehension and Application category.

RESULTS and EXAMINERS' COMMENTS

This examination has a balance of question types and difficulties. It is designed so that a student capable of achieving the acceptable standard would obtain a mark of 50% or higher and students achieving the standard of excellence would obtain a mark of 80% or higher. Even though the structure of this examination is similar to previous examinations, a greater number of students were successful in meeting the acceptable level. Future examinations will continue to require students to demonstrate clarity in their thinking as well as to demonstrate their understanding of concepts by applying their knowledge to new and novel situations. Students needed to achieve these expectations to be successful on this examination.

MULTIPLE CHOICE

QUESTION	KEY	DIFFICULTY*	QUESTION	KEY	DIFFICULTY	QUESTION	KEY	DIFFICULTY
1	A	82.9	18	A	85.1	35	C	85.2
2	A	80.7	19	C	77.0	36	C	36.3
3	D	58.6	20	B	92.0	37	A	79.1
4	A	57.5	21	A	76.8	38	A	51.5
5	C	77.5	22	C	72.0	39	B	88.0
6	D	72.4	23	D	79.7	40	A	60.1
7	A	89.5	24	C	24.0	41	D	70.9
8	C	62.6	25	B	76.4	42	A	38.3
9	B	86.6	26	A	71.9	43	A	90.3
10	B	81.3	27	D	60.6	44	B	80.1
11	D	49.5	28	D	75.2	45	B	67.8
12	B	66.3	29	C	80.8	46	D	71.2
13	C	38.3	30	B	76.7	47	D	57.2
14	C	72.1	31	C	46.9	48	C	76.1
15	D	49.3	32	B	46.2	49	B	81.9
16	B	87.8	33	C	82.7			
17	A	91.5	34	D	65.3			

*Difficulty – percentage of students answering the question correctly

MULTIPLE CHOICE (continued)

The questions that follow are selected to exemplify what is required to meet the acceptable standard and the standard of excellence.

9. For the combustion of methanol, $\text{CH}_3\text{OH}(l) + \frac{3}{2}\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(g)$, which is a component of gasohol, the molar heat of combustion is

A. -148.9 kJ/mol
*B. -638.1 kJ/mol
C. -874.3 kJ/mol
D. -1116.1 kJ/mol

24. A barium hydroxide solution of 1.0×10^{-2} mol/L concentration has a pH of

A. 2.00
B. 12.00
*C. 12.30
D. 13.70

Question 9 showed that most students (86.6%) could correctly calculate a molar heat of reaction. Those students who answered incorrectly did not appear to make the same mistake, which suggests that students achieving the acceptable standard are able to perform standard single-step stoichiometric calculations required to determine molar heats of reaction.

Question 24 showed that 82.0% of the students could recognize a basic solution. Unfortunately, over half these students did not recognize that there is a ratio between solute and dissolved ions, and hence they omitted the 1:2 ratio. Consequently, fewer than one-third of the students (24.0%) correctly answered the question. This result suggests that most students, except those achieving the standard of excellence or close to it, have difficulty recognizing ratios other than 1:1 in acid-base chemistry.

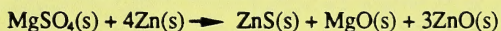
NUMERICAL RESPONSE

Most students correctly followed the instructions for filling in the answer sheet. Students who wrongly recorded correct answers were not penalized. A smaller number of students who did not round their answers as instructed were penalized, as were students who did not put their answers into scientific notation.

The average for **question 6** was 11.1%, and it provided a high base of discrimination between strong and fairly strong students. The most frequent mistake students made (21.9%) was failing to divide the heat of reaction by the moles of reducing agent. This probably came about because the students were unable to identify the reducing agent. A similar question, question 1 in the numerical-response section, required the students to determine the heat of reaction, and 80.8% of the students were successful. The only difference between these two questions was the requirement to combine concepts from different units. The results for question 6 suggest that students achieving the standard of excellence can successfully transfer and apply concepts from one unit to another.

Question	Answer	Difficulty (%)
1	57.0	80.8
2	3, 9, 4, 8	25.9
3	7.35	54.3
4	4, 4, 4, 4,	22.6
5	2, 3, 1, 4	77.7
6	1.42	11.1
7	1, 3, 4, 2	80.0

Use the following information to answer question 6.



6. The molar heat of reaction for the reducing agent in joules per mole is _____ $\times 10^5$ J/mol. (Give your answer to three digits.)

Use the following information to answer question 7.

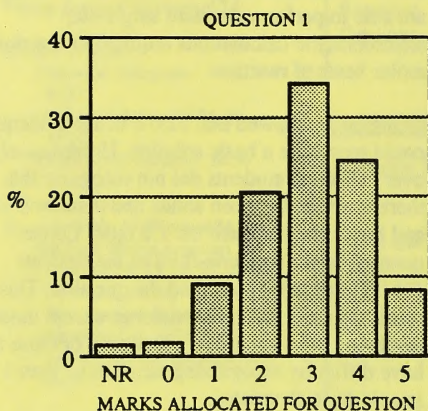
- | | |
|----------------------------|--------------------------------|
| 1. Cr(s) | 3. $\text{Sn}^{2+}(\text{aq})$ |
| 2. $\text{H}_2\text{O}(l)$ | 4. $\text{Fe}^{3+}(\text{aq})$ |

7. The order of these reducing agents from strongest to weakest is _____, _____, _____, _____.

The average for **question 7** was 80.0%, and it provided a basis for discrimination between fair and weak students. The most common mistake students made (4.2%) was selecting $\text{Fe}^{2+}(\text{aq})$ as the next strongest reducing agent after Cr(s). Another common mistake (2.9%) was the listing of the agents from weakest to strongest, which implies that students may have looked up oxidizing agents rather than reducing agents. These errors suggest that students achieving the acceptable standard can do so because they are capable of tasks such as ranking reducing agents by their strength, utilizing the data booklet.

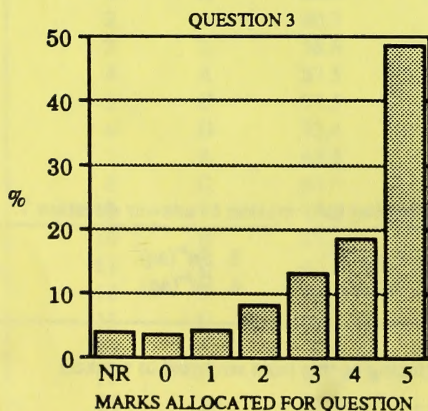
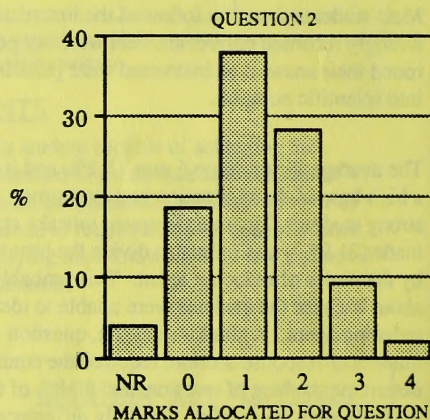
WRITTEN RESPONSE

The level of achievement on the written-response section was better than expected; almost three-quarters of the students (74.1%) achieved a mark of 7 or better out of 14. This was due to the excellent performance on question 3. Students' performance on questions 1 and 2 was as expected.



Question 1 results showed that one-third of the students were unable to solve the question and, as a result, obtained a mark of 2 or less. These students had difficulty in balancing a chemical equation, were unable to identify a method that would successfully identify the unknown as gallium, and could not distinguish between heat and molar heat of reaction. They were, however, able to identify the Δt of the calorimeter and were able to solve the calorimetric aspect of the problem. Students who attained the acceptable standard but not the standard of excellence recognized the difference between heat and molar heat of reaction and, as a result, were able to determine the correct numeric value. They were also able to identify a variable that could be used to identify the unknown. Unfortunately, they were unable to propose a method that utilized their variable. The two most common errors this group made were that they failed to use units consistently and that they confirmed that the element was gallium rather than identifying the unknown. Students who attained the standard of excellence did so because they identified a variable and stated a method that led to the identification of the element. In addition, they were consistent with their use of significant digits and units throughout. The common error that prevented these students from earning full marks in this question was failing to indicate that the energy was released by either using a negative sign on the ΔH°_f value or by stating in a summary statement that the energy was released. On this 5-mark question, the average mark was 2.93 or 59% of the available mark.

Question 2 was answered as well as was expected. It should be noted that the intent of this question was to distinguish between students at the acceptable standard and at the standard of excellence. Therefore, students not attaining the acceptable standard were not expected to score well on this question. These students seemed to understand "endpoint" in terms of indicators and colors. However, they did not frame their response as an experimental procedure. Students who attained the acceptable level on the examination were expected to score either 1 or 2 on this question. They were able to do this by identifying experimental procedures that would obtain results suitable to determine the endpoint and the equivalence points of a titration. However, they were unable to apply this knowledge to distinguish between these points. The most common error of these students was in making the distinction between chemical equivalency and equal concentration or volume. Students who attained the standard of excellence were expected to score 2 or better on this question. They did so by identifying experimental procedures that would work, and they were able to state the similarities and differences between the two points. In general, these students had a good grasp of indicators and related colors, and knew how to select indicators so that the color changed at or close to the equivalence point. Students received lower marks for lack of clarity, implied procedures, and incomplete explanations. On this 4-mark question, the average mark was 1.30 or 33% of the available mark.



Question 3 was answered better than expected. It should be noted that the intent of this question was to distinguish between students below the acceptable standard and at the acceptable standard. Students who failed to attain the acceptable level on the examination were expected to score either 1 or 2 on this question. They did this by correctly identifying the half-reactions and using this information to write a balanced net ionic equation. In addition, they were able to use appropriate methods for determining the mass of the iron in the sample and the correct number of significant digits in the final answer. The most common mistakes that this group made were omitting or inverting the mole ratio, incorrectly determining the volume of $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$, not using units in calculations, and not including physical states in half-reactions and the balanced chemical equation. Students who attained the acceptable standard were able to determine the correct mole ratio and the volume of $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$, and included states in their half-reactions and the balanced chemical equation. In general, these students performed the stoichiometric process well; they paid careful attention to rounding off to the proper number of significant digits and to the use of units throughout. However, they did not pay the same attention to detail in the overall organization of their responses. On this 5-mark question, the average mark was 3.77 or 75% of the available mark.

For further information, contact Don Loerke, Yvonne Johnson, or Phill Campbell at the Student Evaluation Branch, 427-2948.

